7.0 Quality Assurance

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Quality assurance and quality control practices encompass all aspects of Hanford Site environmental monitoring and surveillance programs. Samples are collected and analyzed according to documented standard analytical procedures. Analytical data quality is verified by a continuing program of internal laboratory quality control, participation in interlaboratory crosschecks, replicate sampling and analysis, submittal of blind standard samples and blanks, and splitting samples with other laboratories.

Quality assurance/quality control for the Hanford Site monitoring program also includes procedures and protocols for 1) documenting instrument calibrations, 2) conducting program-specific activities in the field, 3) maintaining wells to ensure representative samples are collected, and 4) using dedicated well sampling pumps to avoid cross contamination.

This section discusses specific measures taken to ensure quality in project management, sample collection, and analytical results.

Environmental Surveillance and Groundwater Monitoring

Comprehensive quality assurance programs, including various quality control practices, are maintained to ensure the quality of data collected through the environmental surveillance and groundwater monitoring programs. Quality assurance plans are maintained for all program activities and define the appropriate controls and documentation required by EPA and/or DOE for the project-specific requirements.

Project Management Quality Assurance

Site environmental surveillance, groundwater monitoring, and related programs such as processing of thermoluminescent dosimeters and performing dose calculations are subject to an overall quality assurance program. This program implements the requirements of DOE Order 5700.6C. The program is defined in a quality assurance manual (Pacific Northwest Laboratory 1992).

The groundwater monitoring and site surveillance projects have current quality assurance plans that describe the specific quality assurance elements that apply to each project. These plans are approved by a quality assurance organization that conducts surveillances and audits to verify compliance with the plans. Work performed through contracts, such as sample analysis, must meet the same quality assurance requirements. Potential equipment and services suppliers are audited before service contracts or material purchases that could have a significant impact on quality within the project are approved and awarded.

Sample Collection Quality Assurance/ Quality Control

Environmental surveillance samples were collected by staff trained to conduct sampling according to approved and documented procedures (Hanf and Dirkes 1996). Continuity of all sampling location identities is maintained through careful documentation. Field duplicates are collected for specific media, and results are addressed in the individual media sections (3.0, "Facility-Related Monitoring, Waste Management, and Chemical Inventory Information," and 4.0, "Environmental Surveillance Information").

Samples for the Hanford Site Groundwater Monitoring Program are collected by trained staff according to approved and documented procedures (Pacific Northwest Laboratory 1993, Westinghouse Hanford Company 1988). Chain-of-custody procedures are followed (EPA 1986b) that provide for the use of evidence tape in sealing sample bottles to maintain the integrity of the samples during shipping. Full trip blanks and field duplicates were obtained during field operations. Summaries of the 1996

groundwater field quality control sample results are provided in the 1996 fiscal year site groundwater monitoring report (Hartman and Dresel 1997). The percentages of acceptable field blank and duplicate results in fiscal year 1996 were very high, 94% for blanks and 98% for field duplicates.

Analytical Results Quality Assurance/ Quality Control

Routine hazardous and nonhazardous chemical analyses for environmental and groundwater surveillance and monitoring water samples are performed primarily by DataChem Laboratories, Inc., Salt Lake City, Utah, and Quanterra Environmental Services, St. Louis, Missouri. The laboratories participate in the EPA Water Pollution and Water Supply Performance Evaluation Studies. The laboratories maintain an internal quality control program that meets the requirements of EPA (1986b), which is audited and reviewed by Pacific Northwest National Laboratory and internally. Pacific Northwest National Laboratory submits additional quality control double-blind spiked samples for analysis.

Routine radiochemical analyses for environmental surveillance and groundwater monitoring samples are performed primarily by Quanterra Environmental Services' Richland laboratory. Data from Lockheed Analytical Laboratory, Las Vegas, Nevada, were used in the groundwater evaluations. The laboratories participate in DOE's Quality Assessment Program and EPA's Laboratory Intercomparison Studies. An additional quality control blind spiked sample program is conducted for each project. The laboratories also maintain an internal quality control program, which is audited and reviewed internally and by Pacific Northwest National Laboratory. Additional information on these quality control efforts is provided in the following subsections.

DOE and EPA Comparison Studies

Standard water samples were distributed blind to participating laboratories. These samples contained specific organic and inorganic analytes with concentrations unknown to the analyzing laboratories. After analysis, the results were submitted to EPA for comparison with known values and other participating laboratory concentrations. Summaries of the results during the year are provided in Table 7.0.1. The percentage of EPA-acceptable results was high for both laboratories, indicating excellent performance.

The DOE Quality Assessment Program and EPA's Laboratory Intercomparison Studies provided standard samples of environmental media (e.g., water, air filters, soil, and vegetation) containing specific amounts of one or more radionuclides that were unknown by the participating laboratory. After sample analysis, the results were forwarded to DOE or EPA for comparison with known values and results from other laboratories. Both EPA

Table 7.0.1. EPA Water Pollution/Water Supply Study Results

Laboratory	Water Supply Study January 1996 % Acceptable	Water Pollution Study April 1996 % Acceptable	Water Supply Study September 1996 % Acceptable
DataChem Laboratories, Inc.	94.9[a]	100	93.8[b]
Quanterra Environmental Services	98.3[c]	97.3[d]	95.2[e]

(a) Unacceptable results were for 1-1, dichloroethylene, 1-2,dibromo-3-chloropropane, ethylenedibromide, 1,1,2-trichloroethane, 1,2,3-trichloropropane.
(b) Unacceptable results were for nitrate as N, dieldrin, vinyl chloride, tetrachloroethylene.
(c) Unacceptable result for molybdenum.
(d) Unacceptable results were for aroclor 1016/1242(polychlorinated biphenyl [PCB]), aroclor 1248(PCB), PCB in oil, chlordane.
(e) Unacceptable results were for 1,1-dichloroethylene, 1,2,3-trichloropropane, and sulfate.

and DOE have established criteria for evaluating the accuracy of results (Jarvis and Siu 1981; Sanderson et al. 1996, 1997). Summaries of the 1996 results for the programs are provided in Tables 7.0.2 and 7.0.3.

Pacific Northwest National Laboratory Evaluations

In addition to DOE and EPA interlaboratory quality control programs, a quality control program is maintained by Pacific Northwest National Laboratory to evaluate analytical contractor precision and accuracy and to conduct special intercomparisons. This program includes the use of blind spiked samples. Blind spiked quality control samples and blanks were prepared and submitted to check the accuracy and precision of analyses at DataChem Laboratories, Inc. and Quanterra Environmental Services. In 1996, blind spiked samples were submitted for air filters, vegetation, soil, water, and groundwater. Overall, 81% of nonradiochemistry blind spiked determinations were within control limits and 85% of Quanterra Environmental Services' radiochemistry blind spiked determinations were within control limits (Table 7.0.4 and 7.0.5). Overall, this indicates acceptable results.

The Hanford Site Groundwater Monitoring project also submitted total organic halogen and anion (chloride, fluoride, nitrate, and sulfate) split blind spiked samples to several laboratories for evaluation during the year. The discussion and summary of data can be found in Appendix F of Hartman and Dresel (1997).

Pacific Northwest National Laboratory also participates in a Quality Assurance Task Force, a program conducted by the Washington State Department of Health. Public and private organizations from Idaho, Oregon, and Washington participate in analyzing the intercomparison samples. A large soil sample was collected in June 1996 from the 100 Areas to be used as the intercomparison sample. The soil was contaminated with liquid effluent from the single-pass-through reactors. The sample was processed by the Washington State Department of Health by drying, mixing, and sieving. The sample was not pulverized but screened through a 2.0-mm (#10) sieve. The samples were analyzed in triplicate by 11 organizations.

The intercomparison sample was chosen to be representative of the type of sample that may be encountered in cleanup of the 100 Areas liquid disposal facilities. The samples were analyzed for gamma-emitting radionuclides. The primary radionuclides identified were potassium-40, cobalt-60, cesium-137, europium-152, europium-154, and europium-155. The between-laboratory precision for cobalt-60, cesium-137, europium-152, and europium-154 was in the range of 11% to 14% (1-sigma). The europium-155 concentration was low, below, or near the minimum detectable concentration for some laboratories and, therefore, the precision was higher. Table 7.0.6 provides the Pacific Northwest National Laboratory results with respect to the grand mean of the study. The results fell within the ±2 standard error of the mean of the concentration of the other participating laboratories and were acceptable.

Laboratory Internal Quality Assurance Programs

DataChem Laboratories, Inc. and Quanterra Environmental Services are required to maintain internal quality control programs. Periodically, the laboratories are internally audited for compliance to the quality control programs. At DataChem and Quanterra St. Louis laboratories, the quality control programs meet the quality control criteria of EPA (1986b). The laboratories are also required to maintain a system for reviewing and analyzing the results of the quality control samples to detect problems that may arise from contamination, inadequate calibrations, calculation errors, or improper procedure performance. Method detection levels are determined at least annually for each analytical method.

The internal quality control program Quanterra Environmental Services' Richland involves routine calibrations of counting instruments, yield determinations of radiochemical procedures, frequent radiation check sources and background counts, replicate and spiked sample analyses, matrix and reagent blanks, and maintenance of control charts to indicate analytical deficiencies. Available calibration standards traceable to the National Institute of Standards and Technology were used for radiochemical calibrations. Minimum detectable concentration verification is conducted (when requested by the project) for radionuclide-media combination analyses. Calculation of minimum detectable concentrations involves the use of factors such as the average counting efficiencies and background for detection instruments, length of time for background and sample counts, sample volumes, radiochemical yields, and a predesignated uncertainty multiplier (EPA 1980).

Periodically, inspections of services are performed, which document conformance with contractual requirements of

Table 7.0.2. Summary of Laboratory Performance on DOE Quality Assessment Program Samples, 1996

Medium	Radionuclides	Number of Results Reported for Each Analyte	Number Within AcceptableControl Limits[a]
	Quanterra Environmental Services, Richland, Washington		
Air filter particulate	^{241}Am, ^{57}Co, ^{60}Co, ^{134}Cs, ^{137}Cs, Total alpha, ^{54}Mn, ^{238}Pu, ^{106}Ru, ^{125}Sb, ^{90}Sr, ^{234}U, ^{238}U, U total	2	2
	Total beta	2	1
	^{144}Ce, ^{239}Pu	1	1
Soil	^{241}Am, ^{137}Cs, ^{40}K, ^{238}Pu, ^{239}Pu, ^{90}Sr, U total	2	2
	^{244}Cm, ^{60}Co, ^{234}U, ^{238}U	1	1
Vegetation	^{241}Am, ^{244}Cm, ^{60}Co, ^{134}Cs, ^{40}K, ^{239}Pu, ^{90}Sr	2	2
Water	^{241}Am, ^{60}Co, ^{137}Cs, Total alpha, Total beta, ^{3}H, ^{54}Mn, ^{238}Pu, ^{239}Pu,^{90}Sr	2	2
	U total	2	1
	^{55}Fe	1	1
	Lockheed Analytical Laboratory, Las Vegas, Nevada		
Air filters	^{241}Am, ^{57}Co, ^{60}Co, ^{134}Cs, ^{137}Cs, Total alpha, Total beta, ^{54}Mn, ^{238}Pu, ^{106}Ru, ^{125}Sb, ^{90}Sr, ^{234}U, ^{238}U, U total	2	2
	^{144}Ce, ^{239}Pu	1	1
Soil	^{241}Am, ^{137}Cs, ^{40}K, ^{238}Pu, ^{239}Pu, ^{90}Sr, U total	2	2
	^{244}Cm, ^{60}Co, ^{234}U, ^{238}U	1	1
Vegetation	^{60}Co, ^{134}Cs, ^{40}K, ^{239}Pu, ^{90}Sr	2	2
	^{241}Am, ^{244}Cm	2	1
Water	^{241}Am, ^{60}Co, ^{137}Cs, Total alpha, ^{3}H, ^{54}Mn, ^{238}Pu, ^{239}Pu, ^{90}Sr	2	2
	^{55}Fe	1	1

(a) Control limits are from Sanderson et al. (1996, 1997).

Table 7.0.3. Summary of Laboratory Performance on EPA Intercomparison Program Samples, 1996

Medium	Radionuclides	Number of Results Reported for Each Analyte	Number Within Control Limits for Each Analyte[a]
	Quanterra Environmental Services, Richland, Washington		
Water	^{133}Ba, ^{3}H, ^{131}I, ^{65}Zn	2	2
	^{60}Co, ^{134}Cs, ^{137}Cs, ^{89}Sr, ^{90}Sr	4	4
	Total alpha, Total beta, U total, ^{226}Ra	5	5
	^{228}Ra	5	4
	Lockheed Analytical Laboratory, Las Vegas, Nevada		
Water	^{131}I	1	1
	^{133}Ba, ^{3}H, ^{65}Zn	2	2
	^{60}Co, ^{137}Cs, Total alpha, Total beta, ^{89}Sr, ^{90}Sr	4	4
	^{134}Cs	4	3
	^{226}Ra, ^{228}Ra	5	5
	U total	5	4

(a) Control limits are from Jarvis and Siu (1981).

the analytical facility and provide the framework for identifying and resolving potential performance problems. Responses to audit and inspection findings are documented by written communication, and corrective actions are verified by follow-up audits and inspections. There were no scheduled inspections of services performed at DataChem Laboratories, Inc. in 1996; however, the laboratory was frequently contacted regarding questions on results, clarification of methodology, status of scheduled improvements, etc. There was at least one inspection of services performed at Quanterra Environmental Services in Richland, Washington and St. Louis, Missouri.

Internal laboratory quality control program data are summarized by the laboratories monthly or in quarterly reports. The results of the quality control sample summary reports and the observations noted by each laboratory indicated an acceptably functioning internal quality control program.

Media Audits and Comparisons

Additional audits and comparisons are conducted on several specific types of samples. The Washington State Department of Health routinely cosampled various environmental media and measured external radiation levels at multiple locations during 1996. Media that were cosampled included 23 groundwater wells, 5 Columbia River sites, 6 riverbank springs, 2 onsite drinking water systems, 4 offsite water systems, 12 Columbia River sediment sites, 3 air monitoring stations, 15 thermoluminescent dosimeter sites, 1 mule deer, 1 quail, and 1 pheasant. Also cosampled were upwind and downwind samples of leafy vegetables and wine. Results will be published in the Washington State Department of Health 1996 annual report.

The Food and Drug Administration also cosampled leafy vegetables, potatoes, and fruit from upwind and downwind sampling locations. The data are presented in Table 7.0.7.

Table 7.0.4. Summary of Groundwater Surveillance Project Quarterly Blind Spiked Determinations, 1996

	Quanterra Environmental Services and DataChem Laboratories[a]		Quanterra Environmental Services, Richland and St. Louis Laboratories[a]	
Constituent	Number of Results Reported[b]	Number Within Control Limits[c]	Number of Results Reported[b]	Number Within Control Limits[c]
^{3}H	9	9	3	3
^{60}Co	9	9	3	3
^{90}Sr	9	9	3	3
^{99}Tc	9	6	3	3
^{129}I	9	8	3	3
^{137}Cs	9	9	3	3
^{239}Pu	9	5	3	2
U total	9	8	3	3
Chloroform	9	9	3	3
Carbon tetrachloride	9	6	3	2
Trichloroethylene	9	9	3	3
Chromium	9	9	3	3
Cyanide	9	8	3	3
Fluoride	9	6	3	0
Nitrate	9	9	3	3

(a) In the first three quarters, Quanterra Environmental Services and DataChem Laboratories, under a Pacific Northwest National Laboratory contract, were the primary laboratories. During the fourth quarter, contract services were changed to Quanterra Analytical Services under Rust Federal Services Hanford, Inc. Radiochemical data analyses were performed all four quarters by the Richland laboratory.
(b) Blind samples were submitted in triplicate each quarter and compared to actual spike values.
(c) Control limit of ±30%.

Table 7.0.5. Summary of Surface Environmental Surveillance Project Blind Spiked Determinations, 1996

Medium	Radionuclides	Number of Results Reported	Number Within Control Limits[a]
Air filters	^{7}Be, ^{54}Mn, ^{57}Co, ^{60}Co, ^{90}Sr, ^{134}Cs, ^{137}Cs, ^{144}Ce, ^{238}Pu, ^{239}Pu	14	11
Soil	^{40}K, ^{90}Sr, ^{137}Cs, ^{234}U, ^{238}U, ^{238}Pu, ^{239}Pu	13	9
Water	^{3}H, ^{54}Mn, ^{57}Co, ^{60}Co, ^{90}Sr, ^{134}Cs, ^{137}Cs, ^{144}Ce, ^{234}U, ^{238}U, ^{239}Pu	19	16
Vegetation	^{40}K, ^{90}Sr, ^{137}Cs, ^{238}Pu, ^{239}Pu	15	12

(a) Control limit of ±30%.

Table 7.0.6. Comparison[a] of the Quality Assurance Task Force 1996 Intercomparison Sample

Radionuclide	Number of Samples	Intercomparison Sample Concentration, pCi/L
^{40}K		
PNNL (QES)	3	14.1 ± 1.4
Grand mean	30	15.2 ± 2.4
^{60}Co		
PNNL (QES)	3	7.5 ± 0.5
Grand mean	33	7.7 ± 0.8
^{137}Cs		
PNNL (QES)	3	12.2 ± 0.4
Grand mean	33	12.9 ± 1.5
^{152}Eu		
PNNL (QES)	3	38.6 ± 0.9
Grand mean	33	42.9 ± 5.9
^{154}Eu		
PNNL (QES)	3	5.6 ± 0.2
Grand mean	33	6.6 ± 0.6
^{155}Eu		
PNNL (QES)	3	0.5 ± 0.1
Grand mean	7	0.4 ± 0.1

(a) Pacific Northwest National Laboratory (PNNL) analyses by Quanterra Environmental Services (QES) are compared against grand mean (±2 standard error of the mean) of participating laboratories.

Quality control for environmental thermoluminescent dosimeters includes the audit exposure of three environmental thermoluminescent dosimeters per quarter to known values of radiation (between 17 and 28 mR). A summary of 1996 results is shown in Table 7.0.8. On average, the thermoluminescent dosimeter measurements were biased 1% higher than the known values.

Effluent Monitoring and Near-Facility Environmental Monitoring

The site effluent monitoring and near-facility environmental monitoring programs are subject to the quality assurance programs defined in Westinghouse Hanford Company (1989) and Pacific Northwest Laboratory (1992). These quality assurance programs comply with DOE Order 5700.6C using American Society of Mechanical Engineers (1989) as their basis. The programs also adhere to the guidelines and objectives in EPA (1980, 1987).

The facility effluent monitoring and near-facility environmental monitoring programs each have a quality assurance project plan describing applicable quality assurance elements. These plans are approved by contractor quality assurance groups, who conduct surveillances and audits to verify compliance with the plans. Work such as sample analysis performed through contracts must meet the requirements of these plans. Suppliers are audited before the contract selection is made for equipment and services that may significantly impact the quality of a project.

Table 7.0.7. Comparison of Food and Drug Administration Cosampling, 1996

Media	Area	Organization	Potassium-40, pCi/g[a]	Strontium-90, pCi/g[a,b]	Cesium-137, pCi/g[b]
Cherries	Sagemoor	FDA[c]	2.1 ± 0.9	NA[d]	<0.045
		PNNL[e]	2.38 ± 0.41	<0.0021	<0.0071
	Sunnyside	FDA	1.7 ± 0. 8	NA	<0.045
		PNNL	2.08 ± 0.37	<0.0020	<0.0071
Leafy vegetables	Riverview	FDA	2.7 ± 0.9	NA	<0.045
		PNNL	2.63 ± 0.54	0.0087 ± 0.0044	<0.011
	Sunnyside	FDA	2.0 ± 0.9	NA	<0.045
		PNNL	2.63 ± 0.45	<0.0022	<0.0090
Potatoes	Sunnyside	FDA	4.3 ± 0.9	NA	<0.045
		PNNL	4.23 ± 0.53	<0.0034	<0.0061

(a) ±2-sigma total propogated analytical uncertainty.
(b) < values are ±2-sigma total propogated analytical uncertainties.
(c) FDA = Food and Drug Administration.
(d) NA = Not analyzed.
(e) PNNL = Pacific Northwest National Laboratory.

Table 7.0.8. Comparison of Thermoluminescent Dosimeter Results with Known Exposure, 1996

Quarter	Known Exposure, mR[a]	Determined Exposure, mR[b]	% of Known Exposure
February	19 ± 0.70	19.29 ± 0.21	102
	21 ± 0.78	21.28 ± 0.65	101
	27 ± 1.00	28.03 ± 0.71	104
May	17 ± 0.63	17.38 ± 0.17	102
	22 ± 0.81	22.59 ± 0.18	103
	28 ± 1.04	28.80 ± 0.21	103
August	18 ± 0.67	17.92 ± 0.21	100
	25 ± 0.93	24.83 ± 0.58	99
	27 ± 1.00	26.88 ± 0.26	100
November	20 ± 0.74	19.94 ± 0.022	100
	24 ± 0.89	23.95 ± 0.039	100
	28 ± 1.04	27.79 ± 3.5	99

(a) ±2-sigma.
(b) ±2 times the standard deviation.

Sample Collection Quality Assurance

Effluent monitoring and near-facility environmental monitoring samples are collected by staff trained for the task in accordance with approved procedures. Established sampling locations are accurately identified and documented to ensure continuity of data for those sites. Effluent and near-facility environmental sampling locations for the Hanford Site are described in DOE (1994a).

Analytical Results Quality Assurance

Effluent monitoring and near-facility environmental monitoring samples are analyzed by four different analytical laboratories. The use of these laboratories is dependent on the Hanford contractor collecting the samples and contract(s) established between the contractor and the analytical laboratory(s). Table 7.0.9 provides a summary of Hanford's analytical laboratory utilization for effluent monitoring and near-field monitoring samples, which are grouped by contractor and sample media.

The quality of the analytical data are ensured by several means. Counting room instruments, for instance, are kept within calibration limits through daily checks, the results of which are stored in computer databases. Radiochemical standards used in analyses are regularly measured and the results reported and tracked. Formal, written laboratory procedures are used in analyzing samples. Analytical procedural control is ensured through administrative procedures. Chemical technologists at the laboratory qualify to perform analyses through formal classroom and on-the-job training.

The participation of the analytical laboratories in EPA and DOE laboratory intercomparison programs also assists in ensuring the quality of the data produced. Laboratory intercomparison program results can be found in Tables 7.0.10 through 7.0.14 for the Waste Sampling and Characterization Facility, 222-S Analytical Laboratory, and the Pacific Northwest National Laboratory Analytical Chemistry Laboratory. Laboratory intercomparison results for Quanterra Environmental Services were previously provided in Tables 7.0.2 and 7.0.3. In 1996, the EPA intercomparison program deleted some of the analysis categories (e.g., air filters) from the program because of budget reductions.

Table 7.0.9. Laboratories Utilized by Contractor and Sample Type, 1996

	Laboratories Utilized for Effluent Monitoring Samples					Laboratory Utilized for Near-Facility Environmental Monitoring Samples		
	Westinghouse Hanford Company		Pacific Northwest National Laboratory	Bechtel Hanford, Inc.		Westinghouse Hanford Company		
Laboratory	Air	Water	Air	Air	Water	Air	Water	Other
Waste Sampling and Characterization Facility	X	X		X		X	X	X
222-S Analytical Laboratory							X	X
Quanterra Environmental Services, Richland	X		X	X	X	X		
PNNL Analytical Chemistry Laboratory	X	X	X					

Table 7.0.10. Waste Sampling and Characterization Facility Performance on DOE Quality Assessment Program Samples, 1996

Medium	Radionuclide	Number of Results Reported	Number Within Control Limits	Number Outside of Control Limits
Air filters	Total alpha, total beta, ^{54}Mn, ^{57}Co, ^{60}Co, ^{90}Sr, ^{106}Ru, ^{125}Sb, ^{134}Cs, ^{137}Cs, ^{144}Ce, ^{238}Pu, ^{239}Pu, ^{241}Am, uranium	31	30	1[a]
Soil	^{40}K, ^{137}Cs	4	4	0
Vegetation	^{40}K, ^{60}Co, ^{137}Cs	6	6	0
Water	Total alpha, total beta, ^{3}H, ^{54}Mn, ^{60}Co, ^{90}Sr, ^{137}Cs, ^{234}U, ^{238}U, ^{238}Pu, ^{239}Pu, ^{241}Am, uranium	23	22	1[b]

(a) One ^{144}Ce analysis was not within control limits.
(b) One ^{90}Sr analysis was not within control limits.

Table 7.0.11. 222-S Analytical Laboratory Performance on DOE Quality Assessment Program Samples, 1996

Medium	Radionuclide	Number of Results Reported	Number Within Control Limits	Number Outside of Control Limits
Soil	^{40}K, ^{137}Cs	4	2	2[a]
Vegetation	^{40}K, ^{137}Cs, ^{239}Pu, ^{241}Am, ^{244}Cm	7	5	2[b]
Water	^{3}H, ^{54}Mn, ^{60}Co, ^{90}Sr, ^{137}Cs, ^{238}Pu, ^{239}Pu, ^{241}Am, uranium	17	14	3[c]

(a) One ^{40}K and one ^{137}Cs analysis were not within control limits.
(b) One ^{60}Co and one ^{137}Cs analysis were not within control limits.
(c) One ^{60}Co, one ^{241}Am, and one uranium analysis were not within control limits.

Table 7.0.12. Pacific Northwest National Laboratory Performance on DOE Quality Assessment Program Samples, 1996

Medium	Radionuclide	Number of Results Reported	Number Within Control Limits	Number Outside of Control Limits
Air filters	^{54}Mn, ^{57}Co, ^{60}Co, ^{90}Sr, ^{106}Ru, ^{125}Sb, ^{134}Cs, ^{137}Cs, ^{144}Ce, ^{238}Pu, ^{239}Pu, ^{241}Am	23	23	0
Water	^{3}H, ^{54}Mn, ^{60}Co, ^{90}Sr, ^{137}Cs, ^{238}Pu, ^{239}Pu, ^{241}Am, uranium	18	17	1[a]

(a) One uranium analysis was not within control limits.

Table 7.0.13. Waste Sampling and Characterization Facility Performance on EPA Intercomparison Program Samples, 1996

Category	Radionuclide	Number of Results Reported	Number Within Control Limits	Number Outside of Control Limits
Total alpha-beta in water	Total alpha, total beta	6	4	2[a]
Gamma in water	^{60}Co, ^{65}Zn, ^{134}Cs, ^{137}Cs, ^{133}Ba	10	9	1[b]
Strontium in water	^{89}Sr, ^{90}Sr	2	2	0
Uranium-radium in water	Uranium (natural), ^{226}Ra, ^{228}Ra	9	9	0
Tritium in water	^{3}H	1	1	0
Blind A[c]	Total alpha, uranium (natural), ^{226}Ra, ^{228}Ra	8	7	1[d]
Blind B[e]	Total beta, ^{60}Co, ^{89}Sr, ^{90}Sr, ^{134}Cs, ^{137}Cs	12	11	1[f]

(a) Two total alpha analyses were not within control limits.
(b) One ^{134}Cs analysis was not within control limits.
(c) Blind A samples are liquid samples with unknown quantities of alpha emitters analyzed for total alpha and each radionuclide component.
(d) One ^{226}Ra analysis was not within control limits.
(e) Blind B samples are liquid samples with unknown quantities of beta emitters analyzed for total beta and each radionuclide component.
(f) One ^{90}Sr analysis was not within control limits.

Table 7.0.14. 222-S Analytical Laboratory Performance on EPA Intercomparison Program Samples, 1996

Category	Radionuclide	Number of Results Reported	Number Within Control Limits	Number Outside of Control Limits
Total alpha-beta in water	Total alpha, total beta	1	1	0
Gamma in water	^{60}Co, ^{65}Zn, ^{134}Cs, ^{137}Cs, ^{133}Ba	10	10	0
Uranium-radium in water	Uranium (natural)	2	1	1[(a)]
Tritium in water	^{3}H	2	0	2[(b)]
Blind A[(c)]	Total alpha, uranium (natural)	4	2	2[(d)]
Blind B[(e)]	Total beta, ^{60}Co, ^{134}Cs, ^{137}Cs	8	8	0

(a) One uranium (natural) analysis was not within control limits.
(b) Two tritium analyses were not within control limits.
(c) Blind A samples are liquid samples with unknown quantities of alpha emitters analyzed for total alpha and each radionuclide component.
(d) Two uranium (natural) analyses were not within control limits.
(e) Blind B samples are liquid samples with unknown quantities of beta emitters analyzed for total beta and each radionuclide component.